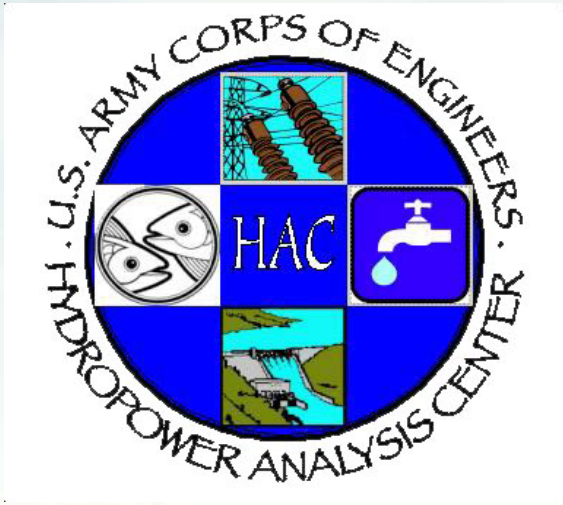
Economics of Chief Joe Turbine Replacement



Corps of Engineers Center of Expertise

for

Hydropower Analysis & Economic Evaluation

US Army Corps of Engineers.

Water Management Division

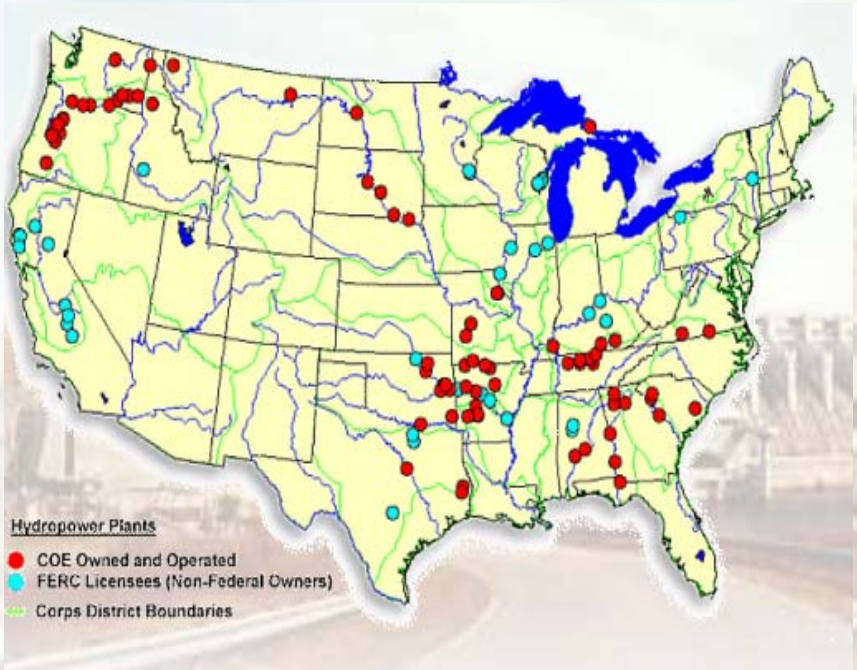
Power Branch

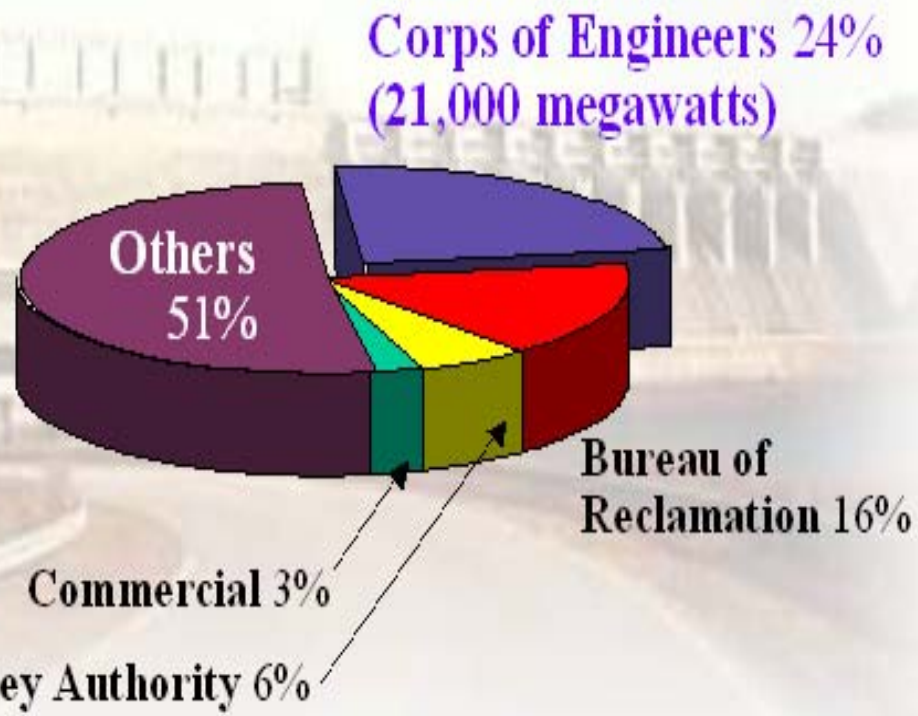
Portland, Oregon

The Corps and Hydropower

Hydro represents 13% of US Electrical Power.

The Corps has an $18 billion investment in hydropower facilities (75 plants; 350 generating units)





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HAC Roles & Capabilities

The HAC has over 50 years of experience in :

- **Powerplant sizing, upgrades, and rehabilitation**
- **River system analysis**
- **Cost allocation and storage reallocation**
- **Power value and benefit computations**
- **Environmental and other powerplant studies**

- **Staff is cross-trained in the power industry & familiar with stakeholders in all regions**
- **Works closely with 16 districts, 4 PMA's, HQUSACE**
- **Helps the COE meet its hydropower functions efficiently**
- **Support USA assistance to other countries (e.g., China, South Korea, Nigeria, Mozambique, etc.).**

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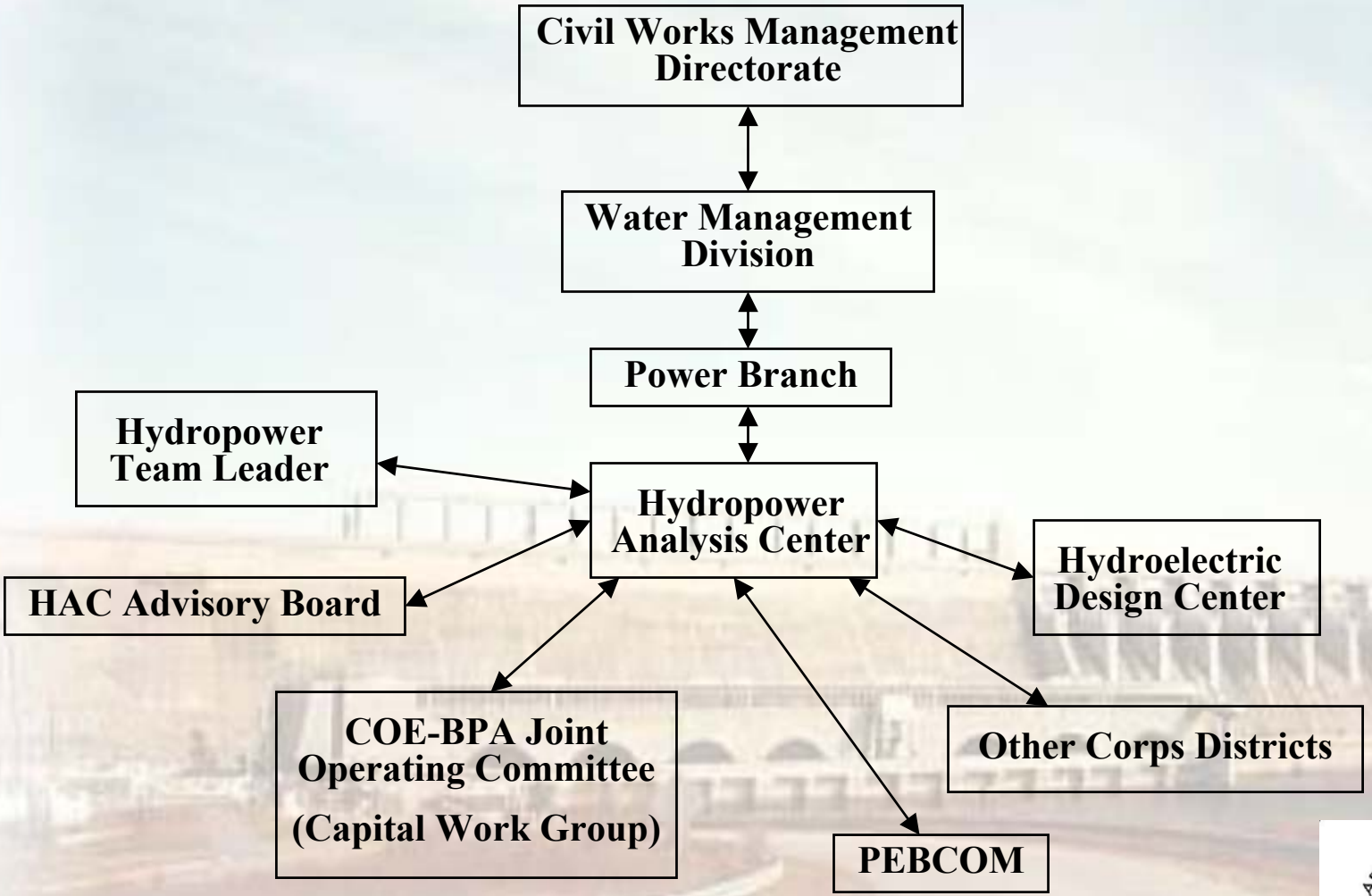
Organization and Affiliations



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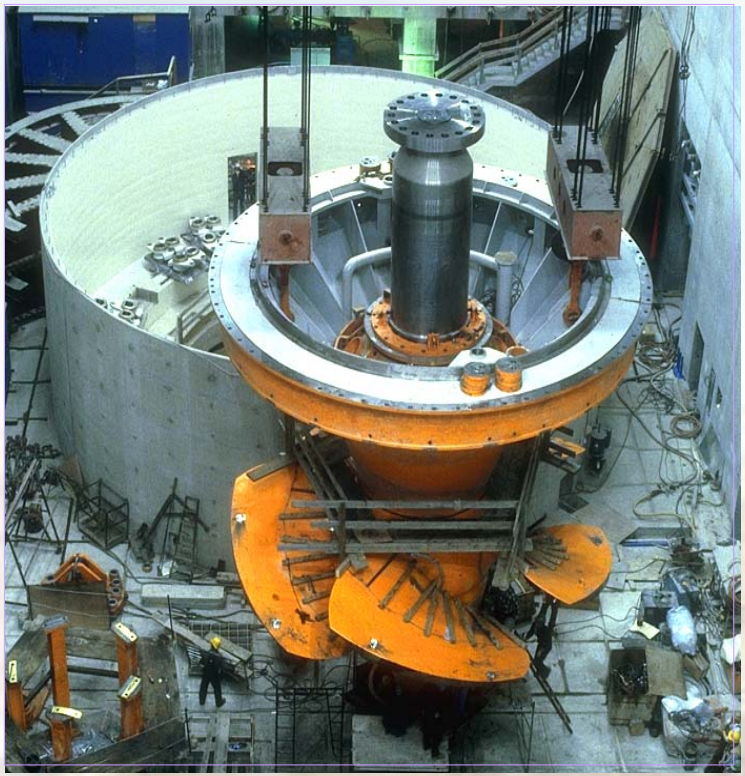
Economics of Chief Joseph Turbine Replacement



- *Available Energy*
- *Turbine Performance Data*
- *Power System Modeling*
- *Economic Analysis*

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Turbine Energy Analysis Model (TEAM)

- **Unit Water Allocation Model (1 to 30 Units)**
- **Flexible & Portable**
- **Weekly Time-steps with Three Sub-periods**
- **Concurrent Weekly Execution**
- **Built on Standard MS Office software (no compilers!!!)**
- **Uses MS Excel Spreadsheet Features with VBA (Visual Basics for Applications)**
- ***Gets the job done!***

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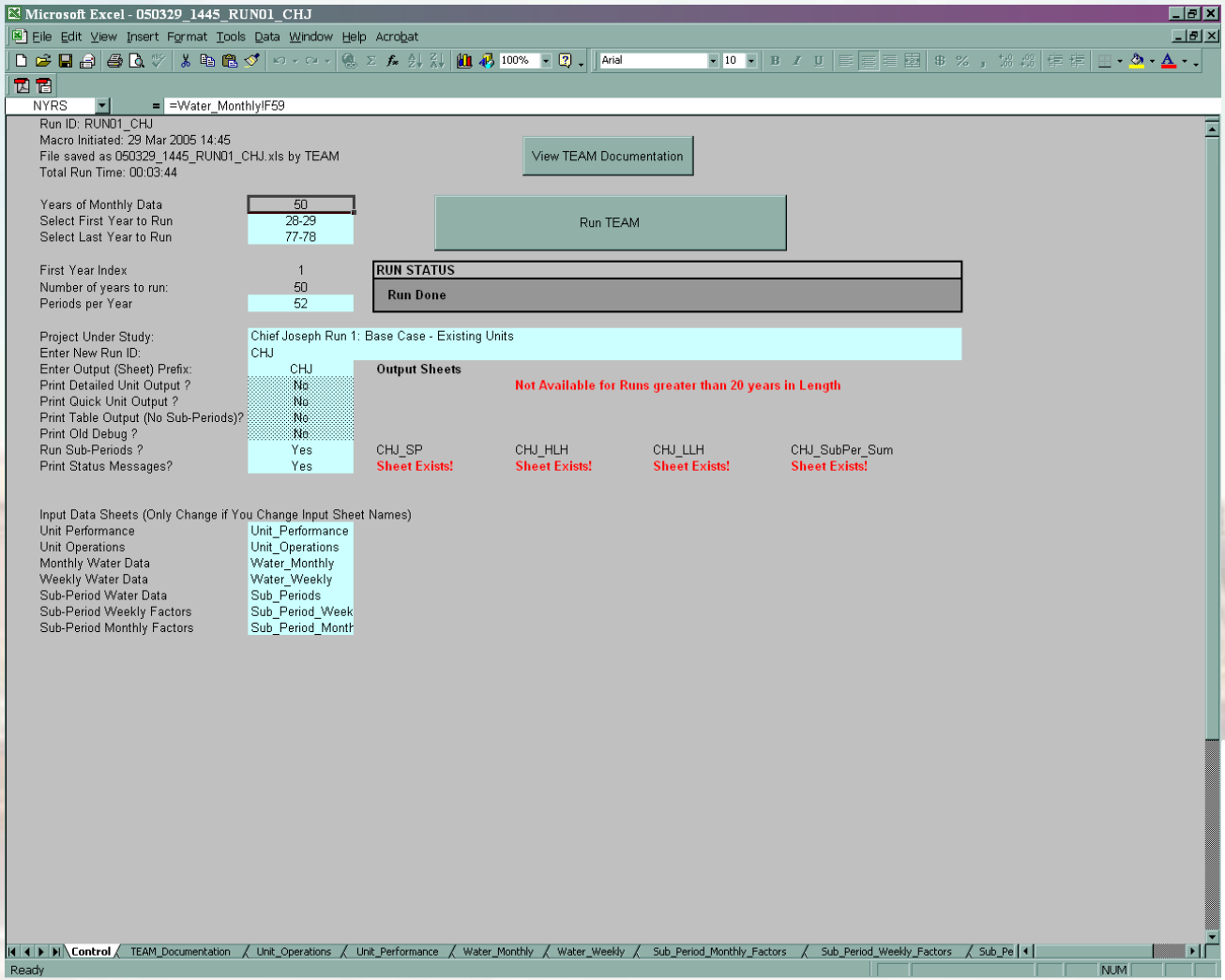
Turbine Energy Analysis Model (TEAM)



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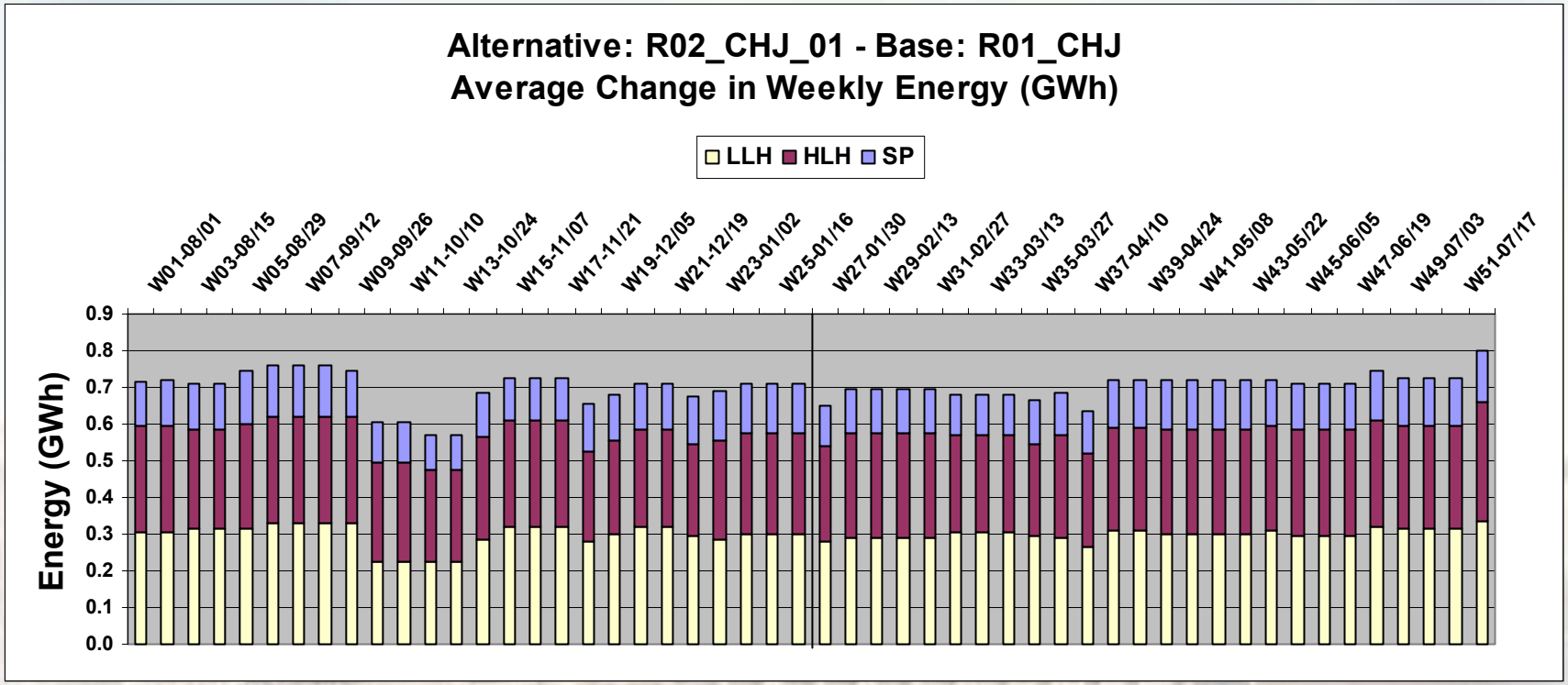
Turbine Energy Analysis Model (TEAM)



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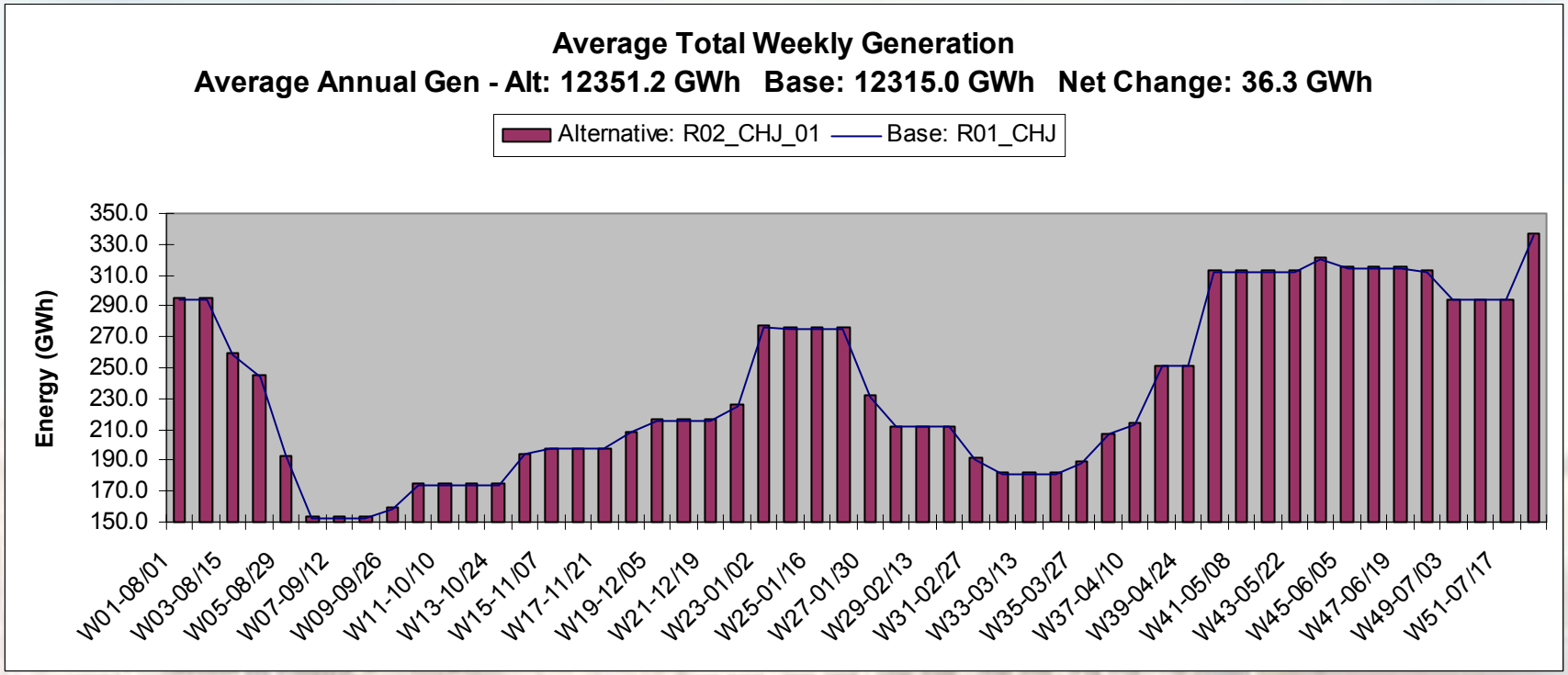

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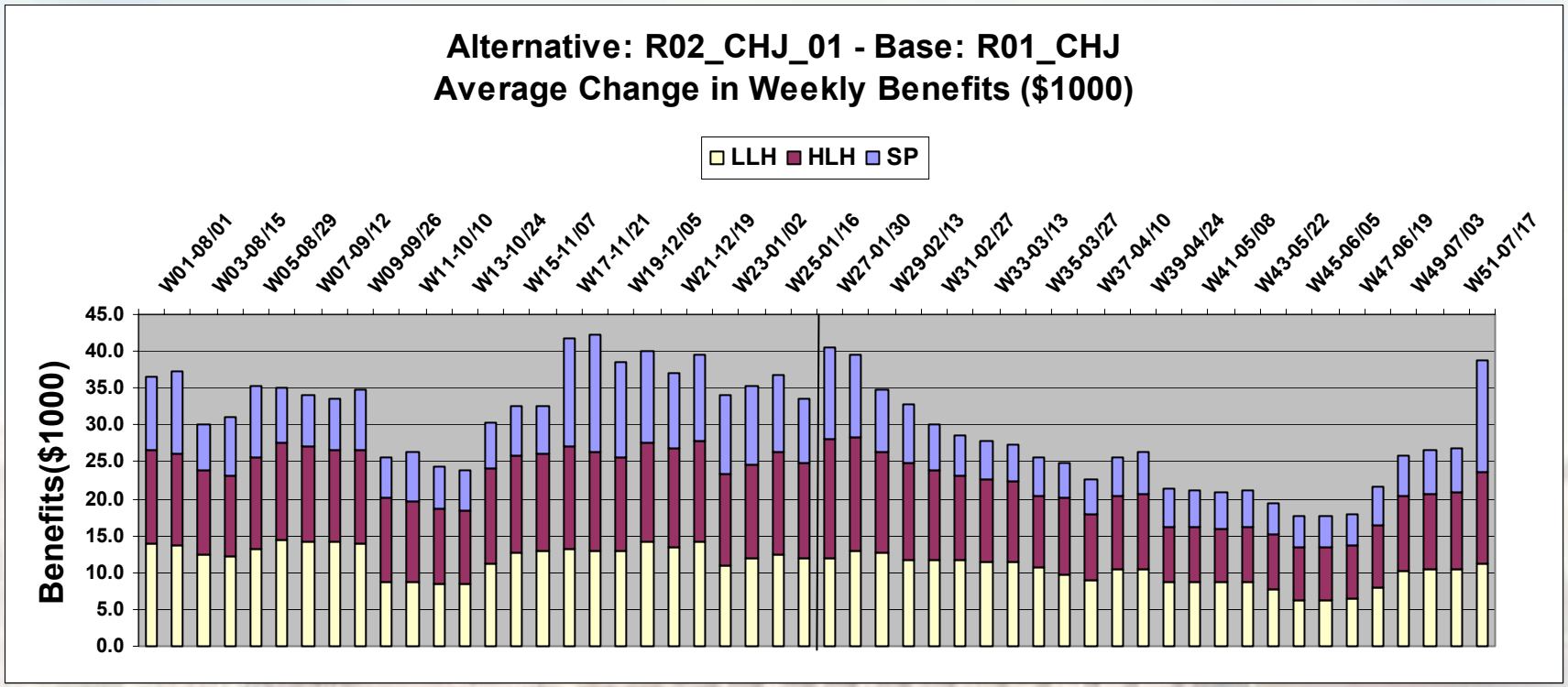

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Chief Joseph Economic Analysis

- **Consider a Range of Alternatives**
- **Determine the Optimal Number of units to Replace**
- **Justify Replacement Using An Incremental Analysis**
- **Perform Sensitivities to Refine Analysis**
- **Document Investment Decisions**

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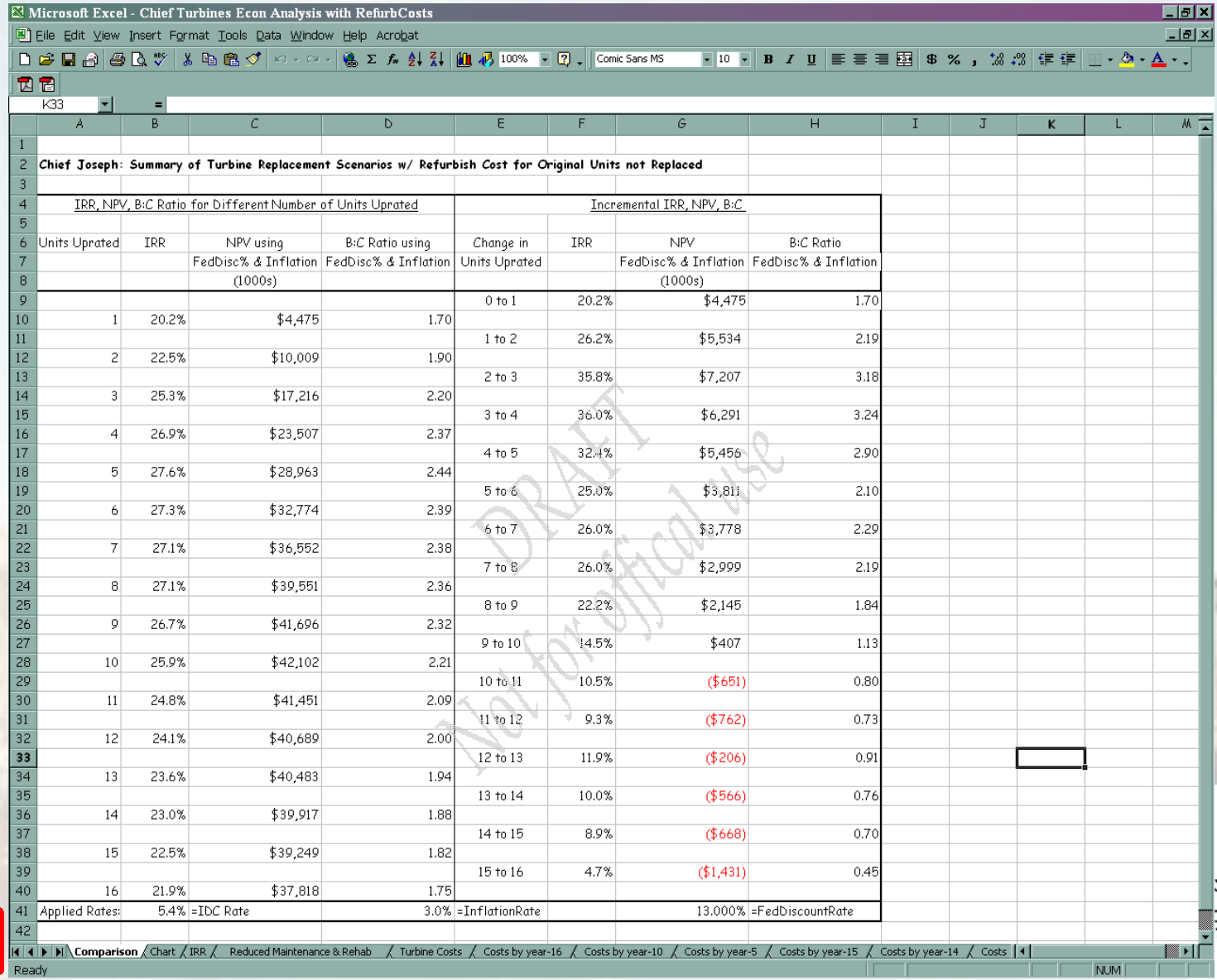
Chief Joseph Economic Analysis



Microsoft Excel - Chief Turbines Econ Analysis with RefurbCosts

File Edit View Insert Format Tools Data Window Help Acrobat

K33 =

Chief Joseph: Summary of Turbine Replacement Scenarios w/ Refurbish Cost for Original Units not Replaced

IRR, NPV, B:C Ratio for Different Number of Units Uprated				Incremental IRR, NPV, B:C			
Units Uprated	IRR	NPV using FedDisc% & Inflation (1000s)	B:C Ratio using FedDisc% & Inflation	Change in Units Uprated	IRR	NPV FedDisc% & Inflation (1000s)	B:C Ratio FedDisc% & Inflation
				0 to 1	20.2%	$4,475	1.70
1	20.2%	$4,475	1.70				
				1 to 2	26.2%	$5,534	2.19
2	22.5%	$10,009	1.90				
				2 to 3	35.8%	$7,207	3.18
3	25.3%	$17,216	2.20				
				3 to 4	36.0%	$6,291	3.24
4	26.9%	$23,507	2.37				
				4 to 5	32.4%	$5,456	2.90
5	27.6%	$28,963	2.44				
				5 to 6	25.0%	$3,811	2.10
6	27.3%	$32,774	2.39				
				6 to 7	26.0%	$3,778	2.29
7	27.1%	$36,552	2.38				
				7 to 8	26.0%	$2,999	2.19
8	27.1%	$39,551	2.36				
				8 to 9	22.2%	$2,145	1.84
9	26.7%	$41,696	2.32				
				9 to 10	14.5%	$407	1.13
10	25.9%	$42,102	2.21				
				10 to 11	10.5%	($651)	0.80
11	24.8%	$41,451	2.09				
				11 to 12	9.3%	($762)	0.73
12	24.1%	$40,689	2.00				
				12 to 13	11.9%	($206)	0.91
13	23.6%	$40,483	1.94				
				13 to 14	10.0%	($566)	0.76
14	23.0%	$39,917	1.88				
				14 to 15	8.9%	($668)	0.70
15	22.5%	$39,249	1.82				
				15 to 16	4.7%	($1,431)	0.45
16	21.9%	$37,818	1.75				
Applied Rates:	5.4%	=IDC Rate	3.0%	=InflationRate		13.000%	=FedDiscountRate

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Comparison | Chart | IRR | Reduced Maintenance & Rehab | Turbine Costs | Costs by year-16 | Costs by year-10 | Costs by year-5 | Costs by year-15 | Costs by year-14 | Costs

Ready NUM

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Chief Joseph Economic Analysis

QUESTIONS??

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